Journal of Pedagogical Research
Volume 9, Issue 4, 2025
https://doi.org/10.33902/JPR.202535249

Research Article

The mediating effect of self-efficacy on perceived teacher autonomy support and deep learning in physical education

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This study examined the mediating role of self-efficacy in the relationship between perceived teacher autonomy support and deep learning in physical education from a selected public higher education institution. Although autonomy-supportive teaching is widely recognized for enhancing student motivation and engagement, the specific processes that facilitate deep learning are not yet fully understood. Particularly in the Philippines, where scholarly works in relation to these constructs, has yet to be documented. Anchored in a quantitative, cross-sectional and predictive design, this study employed Partial Least Squares-Structural Equation Modeling to analyze responses from 655 undergraduate students enrolled in Physical Activity towards Health and Fitness courses. Results indicate that perceived teacher autonomy support has a direct and significant effect on deep learning and self-efficacy. Additionally, self-efficacy positively influences deep learning and serves as a partial mediator in the relationship between perceived autonomy support and deep learning. These findings underscore the importance of fostering autonomy-supportive teaching practices in physical education to cultivate students' confidence in their abilities, leading to deeper cognitive engagement. Despite the established literature on these constructs, existing research has largely focused on primary and secondary education, with minimal studies examining this in physical education in higher education settings. This study bridges that gap by offering empirical evidence from a Philippine higher education institution, contributing to both local and global discussions on effective physical education pedagogy. Future research should explore similar relationships in varied educational contexts to further validate the findings. These insights have implications for curriculum development, emphasizing the role of autonomy-supportive teaching in fostering both cognitive and physical engagement in physical education.

Keywords: Autonomy support; Deep learning; Higher education; Physical education; Self-efficacy

Article History: Submitted 6 March 2025; Revised 21 May 2025; Published online 7 July 2025

1. Introduction

The role of teachers in fostering student motivation and engagement has long been a focal point in educational research (Pedler et al., 2020). In physical education, where learning is both cognitive and physical, teacher autonomy support plays a crucial role in shaping students' learning experiences (Behzadnia et al., 2025). As part of self-determination theory (Deci & Ryan, 1985), '*autonomy support*' refers to teachers providing students with opportunities for choice, encouraging self-initiation, and fostering a supportive learning environment. The degree to which autonomy support is practiced is often influenced by a variety of contextual and institutional factors. These

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How to cite: Lobo, J. (2025). The mediating effect of self-efficacy on perceived teacher autonomy support and deep learning in physical education. *Journal of Pedagogical Research, 9*(4), 1-18. https://doi.org/10.33902/JPR.202535249

include teacher professional development, school climate (Wang, 2024), curriculum flexibility, and the quality of student-teacher interactions (Niemiec & Ryan, 2009). In higher education, particularly in physical education, these factors become critical in shaping students' motivation and engagement. Studies suggest that when students perceive autonomy support from teachers, they are more likely to engage in deep learning, (Zhao & Qin, 2021) a process that involves critical thinking, conceptual understanding, and the ability to transfer knowledge across contexts (Kovač et al., 2023).

However, the mechanisms underlying this relationship, particularly the role of self-efficacy, remain underexplored in the context of higher education in the Philippines. While autonomy-supportive teaching has been widely linked to motivation and learning outcomes, existing research is largely concentrated in Western contexts and among primary and secondary school populations (Brandisauskiene et al., 2023). There is a notable scarcity of empirical evidence exploring how teacher autonomy support facilitates deep learning specifically in tertiary-level physical education within non-Western settings such as the Philippines. Furthermore, although deep learning is a critical educational goal, the psychological mechanisms that may mediate this relationship are insufficiently understood in the physical education [PE] context. Given the increasing emphasis on competency-based education in the Philippines (Dizon & Tolentino, 2022), investigating this mediating role within the local higher education setting is essential.

Meanwhile, 'self-efficacy' or one's belief in their ability to execute tasks and achieve goals, is a key psychological construct influencing student engagement and learning outcomes (Bandura, 2012). The recent findings of Zhao and Qin (2021) suggests that self-efficacy mediates the relationship between perceived teacher autonomy support and deep learning by enhancing motivation and effort persistence. In PE, self-efficacy is especially critical because it shapes students' willingness to engage in complex motor tasks, overcome physical challenges, and set personal goals for improvement (Saks, 2024). Students with high self-efficacy are more likely to persist through frustration, regulate their learning behaviors, and view feedback as an opportunity for growth (Basileo et al., 2024). For example, empirical studies show that students with higher self-efficacy demonstrate improved motor performance, adopt adaptive learning strategies, and participate more actively in physical activity programs (Han et al., 2022). These practical implications underscore the importance of designing PE instruction that not only delivers content but also deliberately fosters students' belief in their capacity to succeed.

In a broader educational context, recent research has also identified a growing teacher self-efficacy gap, particularly in the face of rapid technological change. Anwar et al. (2024) demonstrated that vocational teachers' technology self-efficacy significantly mediates the relationship between infrastructure, social support, and the successful implementation of digital technology practices. Although the present study centers on students' self-efficacy in physical education, these findings emphasize the cross-cutting role of self-efficacy in both teaching and learning within modern educational systems. Given the increasing emphasis on competency-based education in the Philippines (Dizon & Tolentino, 2022), investigating this mediating role within the local higher education setting is essential. This study aims to bridge the gap by exploring how self-efficacy influences the link between teacher autonomy support and deep learning among Filipino university students enrolled in physical education courses.

Most importantly, this study also aligns with the United Nations Sustainable Development Goals [SDGs], particularly SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education). By investigating how autonomy-supportive teaching influences self-efficacy and deep learning in physical education, this research contributes to promoting holistic student development, lifelong physical activity engagement, and inclusive educational practices. These goals are especially relevant in the Philippine higher education context, where efforts to improve instructional quality and student well-being are central to national development priorities.

2. Literature Review

2.1. Perceived Teacher Autonomy Support and Deep Learning

Teacher autonomy support has been consistently linked to improved student motivation, engagement, and deep learning outcomes (Domen et al., 2020). However, it does not operate in isolation. Internal factors such as prior knowledge, interest orientation, and emotional regulation (Lin & Gao, 2023), along with external influences like peer interaction, instructional design, and classroom climate, also contribute meaningfully to these outcomes (Eccles & Roeser, 2011; Schunk & DiBenedetto, 2021). Despite this, autonomy support is especially critical in physical education, where fostering student agency and initiative can significantly enhance learning ownership and persistence. Its grounding in Self-Determination Theory [SDT] reinforces its relevance as a foundational element in promoting deep, self-directed learning in this context. Research shows that when students feel that their teachers encourage autonomy, they develop greater intrinsic motivation, which in turn fosters a deeper approach to learning (Ahn et al., 2021; Evans & Boucher, 2015). In physical education, autonomy-supportive teaching fosters students' sense of ownership over their learning process (Leyton-Román et al., 2020), enhancing their ability to think critically (Ennis, 2017), understand movement concepts (Carriedo et al., 2023) and apply learned skills in practical settings (Jankauskiene et al., 2022). Additionally, students who perceive autonomy support in PE settings are more likely to engage in goal-setting (Cronin et al., 2019), problem-solving (Hagger et al., 2007), and self-reflective practices (Taylor & MacLeod, 2024), all of which contribute to a deep learning approach. Studies in higher education further highlight that autonomy-supportive teaching methods, lead to higher levels of cognitive engagement and academic persistence (Ariati et al., 2025). These evidences suggest that fostering autonomy in class, like physical education, can significantly enhance students' capacity for deep learning and long-term knowledge retention. Despite the relevant literature supporting these findings, most studies have been conducted among elementary and secondary students. Meanwhile, those in higher education often focus on non-PE disciplines. There remains a limited understanding of how teacher autonomy support influences deep learning specifically within physical education in Philippine higher education. Therefore, this study aims to bridge this gap by examining the relationship between autonomy support and deep learning in PE at the higher education level by testing the following hypothesis:

H_1: Perceived teacher autonomy support directly affects deep learning in PE.

2.2. Self-efficacy and Deep Learning in Physical Education

Self-efficacy plays a crucial role in student learning outcomes (Basileo et al., 2024), particularly in skill-based subjects like physical education (Bertills et al., 2021). Students with high self-efficacy are more likely to take on challenges, persist through difficulties, and adopt effective learning strategies that contribute to deep learning (Han et al., 2022; Murfay et al., 2024). According to Ke et al. (2025), students with higher self-efficacy exhibit greater confidence in their physical abilities. This enables them to engage more meaningfully in class activities and achieve higher skill mastery. Additionally, studies indicate that self-efficacy influences students' metacognitive strategies which are essential components of deep learning (Bao et al., 2024). According to (Shi & Qu, 2022), when students believe in their ability to succeed, they invest greater cognitive effort in understanding the material. Furthermore, research in higher education suggests that self-efficacy not only influences academic achievement but also plays a role in fostering resilience (Hitches et al., 2022), reducing anxiety (Hinduja et al., 2024), and enhancing overall well-being in students (Honicke et al., 2023). Despite these established connections, most studies on self-efficacy and deep learning have been conducted among primary and secondary students. On the other hand, those in higher education often focus on other disciplines. Therefore, published scholarly works specifically examining this relationship within physical education in higher education in the Philippines remains insufficient. In this regard, the study tested the following hypothesis:

H_2: Self-efficacy directly influences deep learning in PE.

2.3. The mediating Function of Self-efficacy between Perceived Teacher Autonomy Support and Deep Learning in Physical Education

Based from previously conducted studies, it was observed that teacher autonomy support and learning outcomes can be mediated by self-efficacy (e.g., Zhao & Qin, 2021). According to Ito et al. (2024), it can be construed that students with higher level of self-efficacy can be explained by autonomy support that they receive from their teachers. Furthermore, this can enhance students' motivation and deep learning strategies (Zhao & Liu, 2022). In physical education, this can be manifested by taking their own initiative in their learning, while demonstrating higher level of efforts despite academic obstacles (Maldonado et al., 2019). Recent studies suggest that self-efficacy acts as a crucial link between teacher autonomy support and student learning outcomes (Zhao & Qin, 2021). According to (Mih & Mih, 2013), when students perceive autonomy-supportive teaching, they develop greater self-efficacy. Added by (Qi Li et al., 2022), this can enhance their motivation, engagement, and deep learning strategies. Self-efficacy plays a significant role in enabling students to take control of their learning experiences. This allows them to engage in critical thinking, problem-solving, and the application of learned skills in real-world settings. In physical education, students with strong self-efficacy beliefs are more likely to take initiative in their learning, demonstrate higher levels of effort, and persist despite obstacles, reinforcing the idea that self-efficacy serves as a bridge between teacher autonomy support and deep learning outcomes (Zimmerman, 2000).

Studies have also highlighted that self-efficacy enhances the ability of students to regulate their learning behaviors (Duivenvoorden et al., 2021; Han et al., 2022), a key component of deep learning. Students who believe in their capability to succeed are more likely to adopt self-regulatory strategies to refine their learning approach. Moreover, as emphasized by Ramos-Vallecillo et al. (2024), it fosters higher-order cognitive skills, allowing students to move beyond rote memorization. Niemiec and Ryan (2009) also observed that student may also engage in meaningful learning experiences that enhance their academic performance. Furthermore, self-efficacy plays a mediating role in students' long-term academic engagement and persistence. Research indicates that students with high self-efficacy are more likely to embrace challenges and view failures as opportunities for growth rather than setbacks (Zhao et al., 2021). Resilience fosters a deeper commitment to learning, which is essential in physical education contexts where students must continually refine their skills and adapt to new challenges. Additionally, students with higher self-efficacy tend to exhibit increased intrinsic motivation (Komarraju & Nadler, 2013). This contributes to sustained academic success and deeper learning engagement across various subjects. Moreover, empirical studies have found that students with strong self-efficacy are more likely to actively participate in cooperative learning activities and social interactions (Ahola et al., 2023), further enhancing their deep learning experience. These students engage in meaningful discourse, share insights with peers, and develop a collaborative mindset that enhances their ability to integrate knowledge from different learning domains. This collaborative approach to learning aligns with the principles of deep learning, where students construct knowledge through engagement, reflection, and real-world application. On the other hand, despite the well-documented role of self-efficacy, no studies have yet been conducted to examine its mediating effect between perceived teacher autonomy support and deep learning within physical education in higher education in the Philippines. Existing research has primarily focused on primary and secondary students, with Zhao and Qin (2021) specifically investigating middle school populations. Using Zhao and Qin's (2021) findings as a foundation, this study tested the hypothesis:

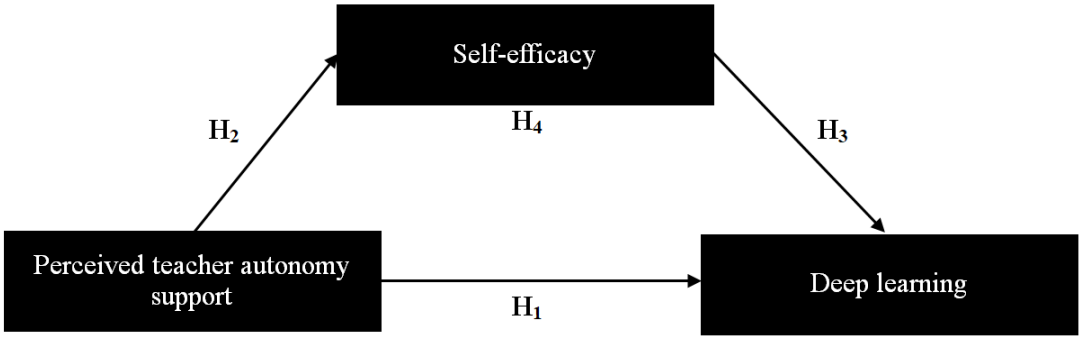
H_3: Self-efficacy mediates the relationship between perceived teacher autonomy support and deep learning in PE.

3. Research Objectives and Conceptual Framework

This study seeks addressed the existing research gap on the mediating role of self-efficacy between perceived teacher autonomy support and deep learning in tertiary-level physical education in the Philippines. Specifically, the objectives of this study are: (1) to determine the direct effect of perceived teacher autonomy support on deep learning in PE, (2) examine the direct effect of perceived teacher autonomy support on students' self-efficacy; (3) analyze the direct relationship between self-efficacy and deep learning in PE; and (4) assess the mediating role of self-efficacy in the relationship between perceived teacher autonomy support and deep learning. The objectives of the study employed a quantitative, predictive design using Partial Least Squares-Structural Equation Modeling [PLS-SEM] to test the hypothesized paths and validate the proposed conceptual framework.

Furthemore, the conceptual framework presented in Figure 1 is grounded in Self-Determination Theory, which emphasizes the importance of autonomy-supportive environments in fostering optimal learning outcomes. The model illustrates the hypothesized relationships in this study, wherein perceived teacher autonomy support is expected to influence deep learning both directly and indirectly through the mediating role of self-efficacy. This framework provided the theoretical and structural basis for formulating the research hypotheses and guided the application of Partial Least Squares Structural Equation Modeling for data analysis.

Figure 1
Conceptual Framework illustrating the hypothesized direct and mediating relationships among perceived teacher autonomy support, self-efficacy, and deep learning



4. Method

4.1. Research Design

This study employed a quantitative, cross-sectional and predictive research design. Grounded in SDT, the research sought to examine the mediating role of self-efficacy in the relationship between perceived teacher autonomy support and deep learning in physical education. The design was guided by a hypothesized structural model tested through Partial Least Squares Structural Equation Modeling, allowing for the simultaneous analysis of both direct and indirect effects.

4.2. Participants

The present study purposively selected first- and second-year undergraduate students from various degree programs enrolled in Physical Activity towards Health and Fitness [PATH-Fit] 2 and 4 offered during the 2nd Semester of the Academic Year 2024-2025 from a selected public higher education institution in the Philippines. PATH-Fit is a tertiary-level physical education course established by the Commission on Higher Education [CHED] in the Philippines, aiming to promote overall health and well-being among students. The selected participants were chosen since all PATH-Fit courses are usually being offered to these year levels. Inclusion criteria are as follow: (a) must be a student of the selected public higher education institution currently enrolled

in PATH-Fit during the stipulated semester and academic year, and (b) students who identify themselves as heterosexual man/woman and/or part of the LGBTQIAP+ community.

Furthermore, *Raosoft Sample Size Calculator* was utilized to determine the recommended sample size from the target population. The approximate number of enrolled students in these courses is 6,500, and the recommended sample size is 363 using 95% confidence level and 5% margin of error. Table 1 depicts the distribution of the respondents according to sex/gender identity. Most of the respondents are heterosexual women (49.0%), followed by heterosexual men (36.3%) and those who identify themselves as part of the LGBTQIAP+ (14.7%) for a total of 655 respondents which is above the target sample size for the present study.

Table 1
Distribution of the respondents enrolled in PATH-Fit 2 and 4 during the second semester of the academic year 2024-2025 from the locale of the present study

Demographic	*Items*	*n(%)*
Sex/Gender identity	Heterosexual men	238 (36.3)
	Heterosexual women	321 (49.0)
	LGBTQIAP+	96 (14.7)

4.3. Instruments

The present study utilized a survey approach through online technology using Google Forms. Online survey offers the advantage of efficient data collection to gather responses quickly, reach a broader audience, and minimize costs versus the traditional pen and pencil method. The data collection commenced from January-February 2025. The online survey was disseminated through the Learning Management Systems of PATH-Fit instructors. From the 781 original responses received during the data collection phase, 655 retained as valid after performing data cleansing procedures. As have mentioned, the total number of respondents is 655 (95% CL and 5% MOE) which far exceeded the target sample size. This corresponds to 83.35% response rate and 215.15% distribution rate. This ensures a higher likelihood of reaching the required sample size, accounting for non-responses, incomplete answers and potential data exclusions.

Additionally, the online survey form is divided into four parts. The first part obtained the sex/gender identity of the respondents. Second, the 15-item Learning Climate Questionnaire [LCQ] by Williams et al. (1996) was utilized. It measured students' perception of their physical education instructors' autonomy-supportive teaching practices. The LCQ items capture multiple dimensions of autonomy-supportive teaching, including the provision of meaningful choices, acknowledgment of student feelings and perspectives, encouragement of open communication, and emotional support (Williams et al., 1996). These indicators reflect the extent to which students perceive their instructor as fostering a learning climate aligned with the core principles of Self-Determination Theory (Williams et al., 1996). A 7-point Likert scale was used to record the responses ranging from 1 (strongly disagree) to 7 (strongly agree). Slight modifications were performed to tailor fit the instrument to the current context of the study.

Third, the 20-item Revised Study Process Questionnaire [R-SPQ2-2F] by Biggs et al. (2001) was also used. In this particular instrument, questions pertaining to deep learning were only selected to be used for the study. The indicators selected from the R-SPQ-2F reflect two key dimensions of deep learning: deep motive, which assesses students' intrinsic interest and commitment to understanding content (Biggs et al., 2001); and deep strategy, which evaluates their use of critical thinking, integration of ideas, and personal engagement with learning tasks (Biggs et al., 2001). These indicators are specifically suited for capturing meaningful learning behaviors in the context of physical education (Biggs et al., 2001). The responses are then encoded using 5-point Likert scale ranging from 1 (this item is never or only rarely true of me) to 5 (this item is always or almost always true of me).

Lastly, the 13-item Self-Efficacy Formative Quetionnaire [SEFQ] by Noonan and Erickson Gaumer (2018) was employed. It examined students' confidence in their ability to succeed in both

academic and practical tasks. The SEFQ indicators measure two core components of self-efficacy: belief in one's personal ability to achieve academic and life goals, and belief that ability can grow through sustained effort (Noonan & Erickson Gaumer, 2018). These items reflect students' confidence in overcoming challenges, developing skills, and persisting in learning, which are all essential for engagement and performance in PE contexts (Noonan & Erickson Gaumer, 2018). A 5-point Likert scale was utilized to enter the responses ranging from 1 (not very like me) to 5 (very like me).

4.4. Data Analysis

Descriptive statistics such as frequency and percentage were used to describe the distribution of the respondents in terms of sex/gender identity. These were performed using IBM Statistical Package for the Social Sciences version 29 of MacOS. Lastly, inferential statistics specifically the Partial Least Squares-Structural Equation Modelling was conducted to determine the relationship between perceived teacher autonomy support and deep learning, and the mediating role of self-efficacy in this relationship.

4.4.1. Normality and variance tests

According to Table 2, all skewness and kurtosis values fall within the acceptable range (−2 to +2 for skewness and −7 to +7 for kurtosis), indicating no significant deviations from normality. The mean values suggest moderate to high perceptions of teacher autonomy support (LCQ = 5.37 ± 1.20), self-efficacy (SEFQ = 4.13 ± .74), and deep learning strategies (RSPQ = 3.72 ± .73). The observed variance values indicate adequate response dispersion, reflecting meaningful variability in participants' perceptions.

Table 2
Variance and normality estimates

Constructs	*Mean±SD*	*Variance*	*Skewness*	*Kurtosis*
LCQ	5.37 ± 1.20	1.441	−.839	1.088
RSPQ	3.72 ± .73	.526	−.158	−.359
SEFQ	4.13 ± .74	.546	−1.147	1.734

Note. Mean and Standard Deviation is illustrated as Mean±SD. Threshold values for skewness [−2, +2] and kurtosi−s [7, +7].

4.4.2. Item loadings, convergent and discriminant validity tests and multicollinearity tests

In the PLS-SEM approach, evaluating item loadings, convergent validity, discriminant validity, and multicollinearity is crucial to ensure the robustness of the measurement model (Hair et al., 2021). The item loadings in Table 3, which measure the strength of the relationship between each indicator and its respective construct, should ideally be ≥ 0.70 (Hair et al., 2021). In this study, all loadings exceed this threshold, confirming that each item contributes meaningfully to its latent variable. Higher loadings, indicate strong indicator reliability, reinforcing the consistency of the measurement model. For convergent validity, Cronbach's Alpha [CA] and Composite Reliability [CR] values should be ≥ 0.70 (Hair et al., 2021), while the Average Variance Extracted (AVE) should be ≥ 0.50 to confirm that constructs explain sufficient variance in their indicators (Hair & Alamer, 2022; Hair et al., 2021). The results in Table 3 indicate strong convergent validity, with LCQ (CR = 0.962, AVE = 0.739), RSPQ (CR = 0.892, AVE = 0.604), and SEFQ (CR = 0.945, AVE = 0.639), all exceeding the acceptable thresholds. These demonstrate high internal consistency and construct reliability, ensuring that the items effectively capture their intended constructs. Lastly, multicollinearity was assessed using the Variance Inflation Factor, where values ≤ 5.0 indicate the absence of problematic multicollinearity (Hair et al., 2021). The highest VIF recorded as depicted in Table 3 was 4.157 (SEFQ10), which is within the acceptable range, confirming that multicollinearity does not pose a concern in the model.

Table 3
Item loadings, reliability, validity and multicollinearity assessments of the model

Variable	*Item*	*Item loadings*	*CA*	*CR*	*AVE*	*VIF*
LCQ	LCQ1	0.854				3.507
	LCQ2	0.879				4.101
	LCQ3	0.819				2.392
	LCQ4	0.898				3.857
	LCQ5	0.893	0.960	0.962	.739	3.843
	LCQ7	0.856				3.009
	LCQ8	0.879				3.749
	LCQ12	0.891				3.080
	LCQ14	0.863				3.504
	LCQ15	0.753				2.364
RSPQ	RSPQ1	0.801				1.701
	RSPQ2	0.733				1.806
	RSPQ6	0.763				1.865
	RSPQ9	0.804	0.891	0.892	0.604	2.060
	RSPQ10	0.817				2.019
	RSPQ13	0.768				2.014
	RSPQ18	0.753				1.755
SEFQ	SEFQ2	0.736				2.038
	SEFQ3	0.754				2.019
	SEFQ4	0.793				2.292
	SEFQ5	0.783				2.436
	SEFQ6	0.755				1.984
	SEFQ7	0.754	0.943	0.945	0.639	2.166
	SEFQ9	0.809				2.740
	SEFQ10	0.887				4.157
	SEFQ11	0.841				2.913
	SEFQ12	0.857				3.241
	SEFQ13	0.813				2.521

Note. Item loadings $\geq$ 0.70, Cronbach's Alpha (CA) and Composite Reliability (CR) $\geq$ 0.70, AVE (Average Variance Extracted) $\geq$ 0.50, VIF (Variance Inflation Factor) $\leq$ 5.0; Legend: LCQ- Perceived teacher autonomy support, RSPQ- Deep learning approach, SEFQ- Self-efficacy.

Discriminant validity ensures that each construct in a PLS-SEM model is distinct from others, confirming that the constructs measure unique concepts. Two common criteria for assessing discriminant validity are the Fornell-Larcker Criterion and the Heterotrait-Monotrait Ratio [HTMT]. The Fornell-Larcker Criterion states that the square root of the AVE (diagonal values) should be greater than the correlations between constructs (off-diagonal values) (Fornell & Larcker, 1981). In this study, the square root of the AVE for each construct is higher than their correlations with other constructs, confirming acceptable discriminant validity as illustrated in Table 4. The HTMT ratio is an alternative measure, with values ≤0.85 (conservative) or ≤0.90 (liberal) indicating acceptable discriminant validity (Henseler et al., 2015). In this study, all HTMT values are $\leq$ 0.85, further supporting discriminant validity as typified in Table 4. Both the Fornell-Larcker Criterion and HTMT values confirm that discriminant validity is established, ensuring that the constructs are conceptually distinct and do not exhibit high redundancy.

Table 4
Discriminant validity testing using Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio

	LCQ	*RSPQ*	*SEFQ*
	Fornell-Larcker Criterion		
LCQ	0.859		
RSPQ	0.535	0.777	
SEFQ	0.483	0.620	0.800
	Heterotrait-Monotrait Ratio (HTMT)		
LCQ			
RSPQ	0.578		
SEFQ	0.506	0.674	

Note. HTMT ratio value < 0.85 (conservative) < 0.90 (liberal) approach.

4.4.3. Model fit estimate

The model fit was evaluated using several indicators, including SRMR (Standardized Root Mean Square Residual), d_ULS (Squared Euclidean Distance), d_G (Geodesic Distance), χ^2 (Chi-Square), and NFI (Normed Fit Index). The findings are as follows: SRMR 0.04; d_ULS 0.63, d_G 0.35, χ^2 value is 1306.478 and NFI 0.91. The SRMR value is <0.08, χ^2 is <=3, and NFI value is within the threshold value which is considered a good fit. In this regard, it can be assumed that the instruments are valid, reliable, and applicable in the current context of the study.

4.5. Ethical Statement

This study was reviewed and exempted from full ethical review by the Local Research Committee of the College of Sports, Exercise, and Recreation, as it solely involved the administration of surveys with minimal risk to participants. The research adhered to ethical principles of voluntary participation, informed consent, confidentiality, and data protection. All responses were collected and analyzed anonymously, ensuring that no personally identifiable information was disclosed. Furthermore, this study complied with the Republic Act No. 10173, also known as the Data Privacy Act of 2012, which safeguards the privacy and security of personal data in research.

5. Results

5.1. Model Explanatory Power

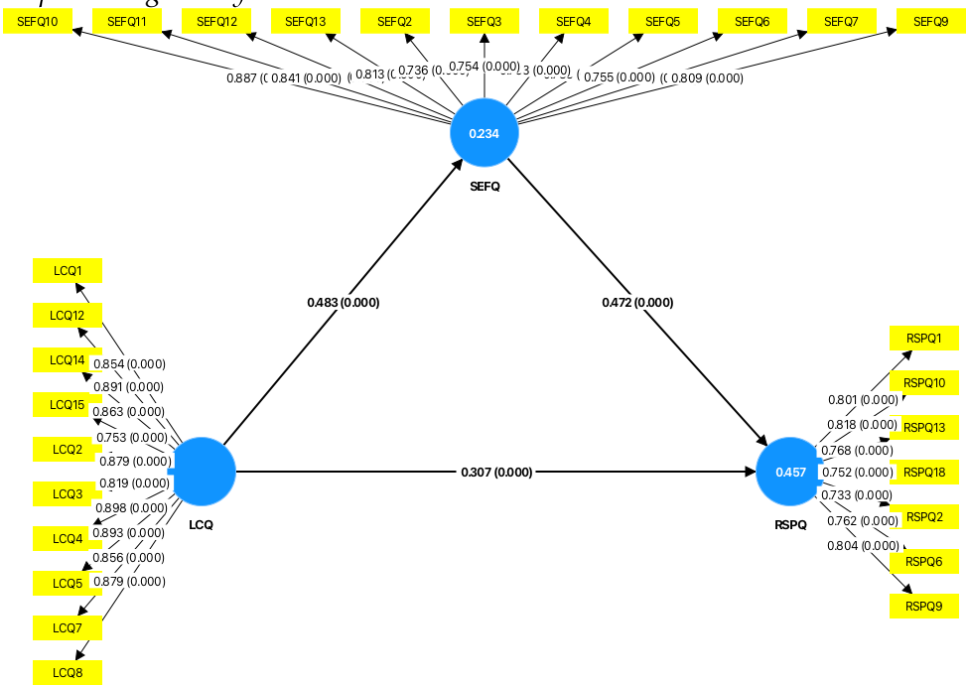
The model's explanatory power was evaluated by measuring the variance explained (R^2) in the dependent variables. Hair et al. (2021) noted that R^2 values and path coefficients are essential for assessing the structural model. As shown in Figure 1, the model has an R^2 value of 0.234 (23.4%) for SEFQ and 0.457 (45.7%) for RSPQ. According to Hair et al. (2021), These R^2 values are considered weak, moderate, and substantial, respectively. Based on this criterion, the model demonstrates weak explanatory power for SEFQ and moderate explanatory power for RSPQ.

5.2. Direct Effect of Perceived Teacher Autonomy Support on Deep Learning in Physical Education

As can be seen in Table 5, the positive and significant relationship between LCQ and RSPQ (β = 0.307, p < .001) suggests that students who perceive their teachers as autonomy-supportive are more likely to adopt deep learning strategies. This implies that when educators provide opportunities for students to make choices, encourage independent thinking, and foster a sense of ownership in their learning, students become more engaged in processing and applying information critically. Autonomy-supportive teaching promotes a learning environment that goes beyond rote memorization, leading students to develop a deeper understanding of concepts and apply knowledge in meaningful ways.

Figure 1

PLS-SEM Model of the mediating effect of self-efficacy between perceived teacher autonomy support and deep learning in Physical Education



5.3. Direct Effect of Perceived Teacher Autonomy Support on Self-efficacy in Physical Education

The strongest effect in the model was observed in the path from LCQ to SEFQ (β = 0.483, p < .001) as illustrated in Table 5. This indicates that autonomy-supportive teaching significantly boosts students' confidence in their ability to succeed academically. When students feel that their teachers respect their perspectives and provide meaningful support, they are more likely to develop a sense of competence and belief in their ability to manage academic challenges. This result aligns with self-determination theory, which highlights the role of autonomy in fostering intrinsic motivation and self-efficacy.

5.4. Direct Effect of Self-efficacy on Deep Learning in Physical Education

A strong positive relationship was also found between SEFQ and RSPQ (β = 0.472, p < .001) as indicated in Table 5, suggesting that students who believe in their capabilities are more likely to engage in deep learning processes. High self-efficacy enables students to persist in challenging academic tasks, employ critical thinking skills, and regulate their learning strategies effectively. This finding reinforces the idea that confidence in one's ability plays a crucial role in determining the extent to which students engage in meaningful learning experiences. This pattern indicates that students with higher self-efficacy are more likely to adopt deep learning behaviors in physical education settings, where cognitive and physical demands often require greater persistence and regulation.

5.5. The Mediating Effect of Self-efficacy between Perceived Teacher Autonomy Support and Deep Learning in Physical Education

Finally, the results in Table 5 indicate that SEFQ partially mediates the relationship between LCQ and RSPQ (β = 0.228, p < .001). This suggests that teacher autonomy support fosters deep learning not only directly but also indirectly through the enhancement of self-efficacy. While autonomy-supportive teaching independently influences students' learning engagement, its effects are further amplified when students develop strong beliefs in their academic abilities. This highlights

the importance of self-efficacy as a psychological mechanism that strengthens the impact of autonomy support on deep learning.

Table 5
Direct and indirect path analyses and hypotheses testing

Hypothesis	*Path*	*Path Coefficient*	*p-value*	*Decision*
H_1	LCQ → RSPQ	0.307	< .001	Accepted
H_2	LCQ → SEFQ	0.483	< .001	Accepted
H_3	SEFQ → RSPQ	0.472	< .001	Accepted
H_4	LCQ → SEFQ → RSPQ	0.228	< .001	Accepted

6. Discussion

The findings suggest that when students perceive their teachers as autonomy-supportive, they are significantly more likely to engage in deep learning, as supported by various studies (Brandisauskiene et al., 2023; Zhao & Qin, 2021). According to Wang et al. (2025), autonomy-supportive teaching creates an environment where learners feel personally invested in their educational experiences. Furthermore, Smith and Darvas (2017) also observed that when students experience autonomy in their learning process, they develop an intrinsic motivation to go beyond surface-level understanding. Additionally, Darling-Hammond et al. (2020) also found out that students will engage in higher-order cognitive processes. These can be in the form of critical analysis, synthesis of information, and creative application of knowledge (Lee et al., 2024). Unlike rigid, controlled learning environments that often lead to passive memorization (Martin-Alguacil et al., 2024), autonomy-supportive teaching empowers students to take ownership of their learning (Lobo, Masagca, Serrano, Reyes, et al., 2024). As Johansen et al. (2023) have mentioned, this can lead students to explore content with curiosity, persistence, and a genuine desire to understand. This highlights the critical role that teachers play in shaping students' engagement with learning. It is not just by delivering information but by fostering an academic climate where students feel responsible for and interested in their intellectual development (Lobo, Masagca, Serrano, Evangelista, et al., 2024). The ability of autonomy-supportive teaching to enhance deep learning suggests that instructional methods should move away from rigid structures that emphasize compliance. Instead, focus on cultivating students' capacity for independent thought and self-directed learning. On the one hand, regardless of the relevant literature supporting these findings, scholarly works on autonomy-supportive teaching and deep learning in PE within Philippine higher education system is still inadequate. Given the teacher-centered approach still common in PE, exploring autonomy support could provide insights into how it enhances student engagement, motivation, and long-term commitment to physical activity. Conducting similar research in this context would clarify its impact on critical thinking and self-directed learning in PE, contributing to both local educational research and the global discourse on effective PE pedagogy.

Another key finding is that perceived teacher autonomy support plays a significant role in enhancing students' self-efficacy. This suggests that when teachers create environments where students have the freedom to make choices students develop a greater sense of confidence in their own abilities (Han, 2021). The psychological foundation of self-efficacy is built upon experiences of competence and mastery (Bandura, 2012), both of which are fostered in autonomy-supportive settings. In contrast, overly controlling or directive teaching approaches may inadvertently undermine students' belief in themselves by limiting their opportunities to take responsibility for their learning (Golann, 2015). By allowing students to navigate challenges on their own, providing meaningful feedback, and offering encouragement that focuses on effort rather than fixed ability, teachers can cultivate an enduring sense of self-efficacy in their students (Zhang et al., 2024). This increase in self-efficacy has broader implications beyond academic performance. It influences students' willingness to take risks, engage in problem-solving and persist through setbacks (Abercrombie et al., 2022). These are essential qualities for success in both education and life.

Therefore, autonomy support should not be viewed solely as a means to promote engagement but as a fundamental approach. In this regard, physical educators should strengthen students' self-belief, helping them develop the resilience and confidence needed to thrive in academic and real-world settings. While existing literature highlights the role of autonomy-supportive teaching in fostering self-efficacy, investigations within PE in Philippine higher education is still insufficient. Given the unique nature of PE, further investigation is needed in this setting. Understanding this relationship could provide insights into how PE instructors can create environments that encourage students to take ownership of their learning, persist through challenges, and develop a stronger belief in their capabilities. Conducting studies in this context would contribute to discussions on effective pedagogical approaches that support student confidence and long-term physical activity engagement.

Furthermore, the findings also emphasize the powerful role of self-efficacy in fostering deep learning. This further solidifies its importance in the academic experience. According to Dolmans et al. (2016), when students believe in their ability to understand complex concepts and successfully complete learning tasks, they are far more likely to adopt deep learning strategies rather than resorting to superficial memorization. Self-efficacy influences how students perceive challenges. According to Benlahcene et al. (2024), those with high self-efficacy approach difficulties as opportunities for growth, demonstrating persistence and adaptive problem-solving skills. On the other hand, Ford et al. (2023) mentioned that those with low self-efficacy may avoid complex tasks due to fear of failure or self-doubt. This suggests that students' cognitive engagement with material is not merely a function of their ability but also their mindset toward learning (Kuhlmann et al., 2024). If students doubt their capabilities, they may disengage from the deeper cognitive processes required for meaningful understanding, despite having the potential to succeed. Therefore, as Zhang et al. (2024) have stated, physical educators must prioritize strategies that enhance self-efficacy. Additionally, Wu et al. (2021) also stressed that that physical educators must also provide constructive feedback that reinforces growth, and encouraging a mastery-oriented perspective rather than one focused solely on performance outcomes. Therefore, as Coutts (2019) have emphasized, fostering a strong sense of self-efficacy empower students to take ownership of their learning. Also, students may persist through intellectual challenges, and actively engage with content in a way that leads to genuine comprehension and critical thinking. However, despite the established link between self-efficacy and deep learning, published works in this constructs within PE in the higher education system is still limited. Given the unique environment in PE, further investigation is needed to determine how self-efficacy fosters deep learning in this context. Deepening the relationship between these constructs would provide deeper insights into how physical educators can foster an environment enhancing students' confidence, resilience and engagement in learning. This will further contribute to a more inclusive discussion on effective pedagogical strategies in physical education.

Moreover, self-efficacy as a mediating factor in the relationship between perceived teacher autonomy support and deep learning reveals an important insight. The present study further solidified Zhao and Qin (2021) findings that autonomy-supportive teaching not only directly enhances deep learning but does so even more effectively when students develop a strong sense of self-belief. Furthermore, it suggests that autonomy alone, while beneficial, is not always sufficient in guaranteeing deep learning engagement. Students must also feel capable of succeeding in their academic tasks. Autonomy creates the conditions for motivation and engagement (Hofferber et al., 2014), but self-efficacy provides the psychological foundation that allows students to act on this motivation (Hafızoglu & Yerdelen, 2019). According to various authors, when students feel both empowered and confident, they are more likely to challenge themselves academically, take intellectual risks, and persist in the face of difficulties (Soutter & Clark, 2023). This highlights the interconnected nature of autonomy and self-efficacy in shaping academic behavior. Autonomy-supportive teaching encourages students to take an active role in their learning (Albashtawi & Al

Bataineh, 2020), while self-efficacy ensures that they feel capable of handling the challenges that come with deeper engagement (Chen, 2024).

Lastly, the mediation effect underscores the importance of a balanced instructional approach where autonomy-supportive teaching is reinforced with intentional efforts to build self-efficacy. Based on the study of Cronqvist (2022) on Teacher Education students, simply providing students with freedom in learning is not enough if they lack the confidence to navigate academic challenges. Therefore, physical educators must ensure that autonomy is coupled with structured support (Albashtawi & Al Bataineh, 2020), targeted skill-building and opportunities for students to experience mastery in their learning. For example, allowing students to make choices in their assignments, while also equipping them with strategies to manage complex tasks, creates a dual impact where autonomy fosters motivation and self-efficacy strengthens the capacity to engage in deep learning. By integrating autonomy-supportive practices with approaches that reinforce self-efficacy, physical educators can maximize the impact of their teaching (Chang et al., 2016). Moreover, this ensures that students not only feel empowered but also fully capable of engaging with content at a deeper level (Franklin & Harrington, 2019).

In summary, the findings provide strong support for the role of teacher autonomy support and self-efficacy in promoting deep learning. While autonomy-supportive teaching directly fosters deep learning, its impact is further enhanced when students develop confidence in their ability to succeed. The mediation effect of self-efficacy highlights that autonomy is not just about giving students control but also about helping them build the skills and confidence to take charge of their learning. This reinforces the idea that effective teaching is not simply about transmitting knowledge but about creating conditions where students feel both empowered and capable of engaging deeply with academic material. Moving forward, educators should recognize the importance of fostering both autonomy and self-efficacy in their teaching practices. This ensures that students not only develop intrinsic motivation but also the belief in their ability to succeed in complex and meaningful learning tasks.

On the one hand, the findings on the mediating effect of self-efficacy between perceived teacher autonomy support and deep learning in the Philippines, specifically in PE in the higher education, remain poorly documented. Performing similar studies across multiple universities, with varied student populations and instructional approaches, would provide deeper insights into how self-efficacy strengthens the link between the constructs studied. Additionally, expanding this research to different higher education institutions, including both public and private universities, and integrating alternative assessment methods such as observational data and performance-based evaluations, would help validate or refine these findings. This would contribute to a more comprehensive understanding of how autonomy-supportive teaching can enhance both cognitive and physical engagement in PE at the higher education level.

This study's findings also align with the United Nations Sustainable Development Goals (SDG 3 and 4). In the context of physical education, deep learning goes beyond academic cognition to encompass lifelong movement literacy, personal agency, and intrinsic motivation for physical activity. By fostering autonomy and building self-efficacy, PE instruction supports not only the development of academic resilience but also the capacity to make independent, health-related decisions. These insights emphasize the global relevance of autonomy-supportive practices in promoting inclusive, high-quality education and lifelong physical well-being.

7. Conclusion

This study underscores the pivotal role of perceived teacher autonomy support in fostering deep learning in physical education, both directly and through the enhancement of self-efficacy. The findings reinforce the importance of shifting from compliance-driven instruction to student-centered pedagogies that cultivate cognitive and physical engagement. Additionally, the results have practical implications for physical education in higher education. Promoting autonomy-supportive teaching practices, such as goal setting, reflective learning, and problem-solving, can

strengthen students' self-efficacy and deepen their learning experience. Teacher training should focus on equipping educators with strategies that build student agency and support lifelong participation in physical activity.

Despite these contributions, several limitations must be acknowledged. This study was conducted at a single university in the Philippines, which may limit generalizability. The cross-sectional design restricts causal inference, and the use of self-report instruments may introduce bias. Additionally, gender was not analyzed as a factor. Future studies should involve multiple institutions, adopt longitudinal designs, incorporate objective measures, and consider gender-related effects.

In conclusion, this study provides empirical support for the importance of teacher autonomy support and self-efficacy in fostering deep learning in PE. These findings inform ongoing efforts to enhance PE instruction through learner-centered approaches that promote engagement, motivation, and sustained learning. Ultimately, cultivating student agency and confidence in PE may lead to broader educational benefits, including stronger commitment to lifelong physical activity and greater academic resilience across disciplines.

Declaration of interest: The author declares that no competing interests exist.

Data availability: The availability of data can be obtained by requesting directly to the corresponding author.

Ethical declaration: This study was reviewed and exempted from full ethical review by the Local Research Committee of the College of Sports, Exercise, and Recreation, as it solely involved the administration of surveys with minimal risk to participants. The research adhered to ethical principles of voluntary participation, informed consent, confidentiality, and data protection. All responses were collected and analyzed anonymously, ensuring that no personally identifiable information was disclosed. Furthermore, this study complied with the Republic Act No. 10173, also known as the Data Privacy Act of 2012, which safeguards the privacy and security of personal data in research.

Funding: The study has been supported by the Bulacan State University, Philippines.

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